

Frank Heart 7/23/94

father worked for otis through the depression, bought a house in yonkers using money from mother and sister.

from time i was six we lived in yonkers...

a somewhat overprotected only child...went to high school in yonkers, and was relatively socially inept...

i wasn't a very good bachelor...

a bit of a bookish,.. a bit of a nerd, as opposed to some of my more outgoing contemporaries...

won the rensalacr math prize....

very good at math in high school. i wanted desperately to go to mit, that was a problem for my parents...

mit gave me a small freshman scholarship, but very small...

what made it diffic. .. won scholarship to cooper union...

the decision to let me go to mit was

i wanted to desperately...

1947 entered MIT.

the overprotectedness caused problems.

not enough housing at mit, veterans were returns rom the war.

lived in the barracks at mit, had temporary housing. dorms couldn't handle the load. to go from my overprotected home in yonkers as an only child to living with 20 people.

little cubicles int he barracks...on campus.

no electives, hellish first years.

there was a rule that if you could find three people that wanted to play bridge you could

recquisitioned the fourth to play.

it was a very tough environment for a young kid.

i hadn't even been to camp much. it was a big shock, being away from home 250 miles and in that kind of environment.

my father was a good engineer and that's no doubt where that came from.

he helped me build things....

i wasn't a very good social animal....

'49: i had decided i wanted to be anelectrical engineer. power lines and transformers, water power. you had to pick something, and they had a few options and one of them was power engineering.

mit had a program called 6a, cooperative, could work a term and go to school a term.

had both a bachelor's and masters. my cooperative co. was general electric.

one summer i worked in pittsfield, ma. in the third shift at a fa ctory making big power transformers. i helping test transformers. working third shift in a unionized factory in western mass. is something you want to do once.

11 p.m. to 7 a.m.

several people from my class working at general electric.

had a little cottage on lake pontusic, had a little boat called bottoms up.

worked another term in lynn , mass. on aircraft gas turbines.
in the course of tryign to become a power engineer, a guy called gorden welchman,
showed up to teach the first programming course ever taught ...taught it one term..
i didn't get into the first class, and always regretted it....always were one term ahead of
me...
it was an unbelievable revelation that a thing like a computer could exist.
then, when i was a senior, i dropped out of the 6a program. this was so h ard to get into,
and students wanted to be in it so badly, the idea of dropping out was unheard of. i got all
sorts of nasty letters from mit and g.e.

i got so excited about computers. got b.s. early and stayed for a master's working at
whirlwind....

whirlwind had been started by the navy.
air defense system: sage. stumbled on whirlwind. most o the people automatically got
transferred to lincoln lab.
i have never looked for a job in my whole life.
worked at lincoln lab for 15 years....

when i first arrived the total storage was 32 toggle switch...
your whole program had to be less than 32 instructions, including the data...
then w.w. got electrostatic storage tubes, which gave it up to 256 registers,
jay forrester invented core memory...which brought it up to 1024...
i programmed...
otherwise i'd have been a power engineer...
when i was at mit oppenheimer showed up to give lectures.

the very newest things tend to be at the best universities.

i taught computer stuff at northeastern for ten years....

the job at whirlwind just became a job at lincoln lab., i just flowed with whirlwind to
lincoln lab.
50 or 60 people involved with whirlwind in one way or another.
it became a division at lincoln.
core memory the first significant memory for computers...
little ceramic tubes like pencile lead...string them like beads, and each ceramic widgie is
able to be magnetically polarized one way or the other....

big patent fight over core memory...

for gquite a while i worked on that air defense system.
sage system: a national air defense system.
then it became clear that the job of building this air defense ssytem would move to a very
large implementation activity.
set up two other organizations to pursue that work:
1) mitre grew out of lincoln, and lots of people transferred to mitre. but i liked mit. i like
being assoc. with mit. i don't like change. then i got involved in a whole lot of other
projects at lincoln...that was the years in which i got a whole lot of experience. all these
diff. connections. built several systems for pointing antennas and underground seismic
arrays...govt built several arrays of seismic detectors ... works like antenna, can figure out
where it came from. have connect each detector to phone lines...can decide it's coming
from thus and so....

worked with a bunch of seismologists. i was expert at connecting computers to things.

Needles project: very unusual.... could communicate between two sides of earth by putting up little needle belt...

had to point two antennas...

all of these things tended to involve computers and programs and phone lines connected computers..

measuring devices..

it's different from straight comm. system because a sensor involved.

connecting computers to interface things.

that was the basic source...

crowther, walden, ornstein and rising all came from lincoln lab matrix.

real-time issues: getting a computer to deal with incoming data was not well

understood....the timing of that kind of thing is very critical. if you do it wrong, it just doesn't work.

when at bbn we were working on the arpanet, went to visit nat. physical lab, they had built a little experimental network.

they thought we were lying when we told them how fast our program operated. they thought we were charlatans.

their machine was running a hundred or a thousand times slower.

by getting people like crowther and walden to write these intricate loops...

a person trying to write a program to handle a data stream, it's a very complicated little problem: it's like playing a very intricate piece on the piano. friedkin has compared it to piano playing.

walden and crowther were artists in terms of being able to produce intricate programs to do high speed things at a maximum rate.

if you save one instruction in a ten-instruction loop could have a program that's ten percent faster.

the group at lincoln, having dealt with that

we had that experience base....

when i left lincoln i was an asst. mgr. of a group. working on the other sets of problems. i worked for a couple of different bosses...

grad. 1951....'51 to '66 ... was still in my mid-30s when i went to bbn.

2) system development corp. was spawned by rand. sdc had large role in implementation of sage. mitre and sdc. took over sage after a while.

how f.h. got to bbn: summer study at woodshole...libraries...being run by head of lincoln: carl overhage...

i was picked to come down and be the worker ant in the back room....

month-long academy meeting on libraries...

danny bobrow: we became very simpatico at the meeting. danny was a very well known a.i. guy and when he was back at bbn they had the problem that jordan baruch had started hospital computer project to try to put computer technology at mass general. at one point in that project bbn decided to try to capitalize. bbn and g.e. set up a new co. called medinet, which left hospital computer project in castleman's hands....

it was like leaving the womb, it had been my only job. the idea of leaving mit and leaving this cushy spot where i had all these people.
once danny suggested it i went out to bbn and talked to a variety of people.
i've always had a do-gooder view of what computers and technology can do for the world.
lincoln had almost specifically decided not to do that.
decided not to go too far afield from their sponsors' needs. severo and wes left because they weren't being allowed to work on what they wanted to work on: computers and life sciences.
when the oppty. to come to bbn came up.....to some place intsd. in medical/life science problems...
oppty. to go work on something different....

when i got to bbn that project was significantly in trouble, and ended up dying. i got there in time to officiate at its funeral. then i did a lot of other things at bbn.
then worked on a project to put computers in doctor's office.

only there 1.5 years when first stirrings of arpanet began to happen.

on roberts:
i was never really a friend of larry's. i wasn't a buddy of larry's.

i watched him play blackjack in a small club in london.

he's speculated in the silver market.

he didn't stand out the way wes did. wes was running a big group. larry was one of a team of very smart talented people. not an obvious greatness shining through. he was a good guy.

all of dec grew out of tx-2 project.

licklider was tom marrill's mentor, and known around bbn. i knew about licklider in that sense.
when licklider went back to arpa a second time, i knew licklider better.

psycho-acoustics:
the whole science of how people listen to sound. the way people react to diff. levels of sound. the whole science of how people react to sound.

two buildings, a tiny 30 foot bridge, not the verrazano narrows bridge...
we did talk to each other. i was a friend of danny's, who was also in this group. the person running it was jerry elkind, and i knew him from yonkers. not like there was no contact. there was a cultural difference...
jordan baruch had collected a whole bunch of crazy people, all mit dropouts....jordan felt that was how he would get the most programming.

i've had trouble with no ph.d. at bbn. crwother is one of the most imaginative and innovative programmers i've ever known. he got intsd. in a certain kind of ...
literally tissue rejection phenomenon. he didn't have ph.d., hadn't read all the papers they had read. they couldn't cope with it. basically it failed. they just couldn't deal with him, and he couldn't deal with them. people take that very seriously.

it's hurt me over the years....you get on fewer national committees....

patty (crowther's 1st wife) was an mit co-ed. an unusual phenomenon. maybe a dozen in a class of 900. always brilliant. got to some big exam and the first people to leave would be these laughing girls, chortling as they left the room.
jane had a hotpoint stove @ home. Jane was rattling on about saying how it had this and that problem, and patty said we had a problem like that and i took it apart and fixed it and now it's fine.

will's a rock climber's rock climber.
his second wife is the antithesis of what you'd imagine to be a rock climber.

would have tried harder in computers and medicine and biology. would have kept working on that. or tried to....

was on the boardwalk of atlantic city. eastern joint computer conference in atlantic city. we were walking along the boardwalk and he mentioned he was getting involved in this and there would be an rfp.

we were all waiting for it and it arrived.
even before it arrived
we made an emotional bid decision that if we possibly could we would try for this. it sounded fascinating ...
it was a new way of thinking... you could interconnect.....
could share programs.
nice if i could run that program whereever it lived and get the results back. very exciting idea.
...
every single one of the other contractors shared the enthusiasm.
people in the technical community using problems had many problems. centers of expertise all spread around. notion that you could get the benefit of labor somewhere else, not have to bother re-inventing that whole program in order to use it. a very exciting idea.

aiken at harvard,, said you figured out bessel functions, what else would you use the computer for. had no clue what else you could use it for.

(katie) so it did take a certain leap of the imagination to...

we were very excited by the prospect of doing this...it seemed

in addition, it was a big contract for little old bbn

this was a day and night, round the clock, seven day a week project to get this proposal out...

i remember working veyr hard on the honeywell problem:
the people running that co. were people i knew prior to being purchased by honeywell.
a numbe of meeting rushing around with honeywell....

since it was such a small group, we had meetings with most of the people.

lots of trading off between what would be in the program and what would be in the honeywell interface hardware.

always a question of what should get done by the program and what should get done by the interface hardware....

i remember a great deal of discussion of technical issues.

kahn had no other life except for this. he worked around the clock.

Section II-6: for many years it kept the system reliable. we were making the point we were making the point that there was a serious technical issue. if you let people meddle with your stuff it's gonna break more.

issues i was very involved in.

the host sites didn't necessarily like all of these conclusions. thought they should be entitled to their opinions. didn't nec. think we should have so much control over how those decisions should be made.

cert. had no input into writing the proposal, but once it was awarded, some concern about some of it.

the one class of things: later on, IMP was pretty good computers. other sites without such big computer wanted to work on the IMP.

some wanted to collect data on what was happening to the imp.

we wanted it to go to the network measurement center.

this was the cream of the u.s. computer intelligentsia. arpa tended to support the very best places in the country doing computer science. involved lots of strong-willed pushy people. didn't always want to be told what to do.

the thing that made it a success as much as it was, the fact that larry roberts controlled the money supply to the host organizations. he was able to legislate cooperation. absolutely crucial.

he was in a position of considerable power.

the host sites had to do a lot of stuff. they had in some ways as much to do as we did. they had to produce hardware eitherface to our specs and software interface somewhat to our specs, and get

had they not been under pressure from arpa, it wouldn't have happened...

we literally sent people on the airplane it was flown on. if we couldn't fly on the same plane, then we flew ahead so we'd be there watching.

we were really concerned to get that thing there in good shape.
from truck to

ruggedized made of sheet steel. not militarized in the mil-spec sense. if you kicked it nothing would happen. deliberate hope that it would not be damaged.

honeywell 516 avail. in commercial version as well.

it was viewed as an ODD thing to do. none of the equipment at the host sites was ruggedized.

we were absolutely concerned about reliability.

people wrote programs and they broke, they went into loops, their performance drops off because some condition... there's a power transient...something fleeting. here this thing is supposed to run for months...and it didn't happen. it was very unusual.

but this computer was connected to all sorts of other things that broke. phone lines, someone turns on a piece of machinery near the phone lines and it degrades....the hardware interface...the applic. program in the host. the imp was in a very complex environment. all those things could break. question was how does this device stay working in the face of all this craziness. a lot of the hardware interface was intended to live through anything that would happen short of a nuclear bomb. could go up or down, stop, go into a loop, clock could go crazy, send things faster or slower.

likewise the imp was set up so that if there was a power transient, it would shut up in an orderly way, then start up again automatically... all kinds of things built in to let the imp live through various troubles.....

and we were able to look into the IMP's memory from a central place, and it was possible to look into the imp's memory from Cambridge.

network was adjusted and reloaded from a central place.
the other thing: network was an evolving thing and the program had to evolve with it. ten imps and you had to add an eleventh.

it was very sophisticated, it was able to discover its environment, could discover automatically that its environment had changed and could automatically start using that location....

cross-patching (looping back): the imp was connected to

how would you tell if it was imp, software in host, software ...

could instruct the imp to loop the interfaces back onto themselves: at each boundary.... imp itself, boundary between imp and phone line, imp and host, to loop back and test it, and isolate where the trouble was....

we had the experience of Lincoln and seismic arrays and antennas that were just sitting there working. there was a lot of background in systems that weren't the same...background from those others that helped us think about these things and anticipate certain problems and

the IIMP was constantly testing all its phone lines. as a regular part of its program, it counted the phone lines, and monitored their quality, and could tell when it was having a problem. counted errors, maybe someone was digging a ditch and phone line went down, or there's a storm.

don't want to use a phone line that's behaving too badly....

would shut that one down....

host site complaint: like having a swimming pool..with a fence around it.

bob (kahn) is complicated.

alan braff